Soil organic carbon dynamics in the Soils of Svalbard (by results of radiocarbon researches)

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The radiocarbon analysis can be applied in soil ecology. One of the problems of soil ecology is an estimation of rate of carbon exchange between soils and atmosphere. The model for evaluation of soils humus renovation has been created on the basis of radiocarbon measurements. It is a unique integrated method of direct measurements of humus activity. For evaluation of organic carbon renovation rate in soils there was offered the coefficient of renovation (Kr), which is the integral index of organic carbon renovation as a result both of biochemical reactions of mineralization and of its migration in the soil profile (Cherkinsky, Brovkin, 1993). The model takes into account changes of concentration of ^{14}C in the atmosphere, which are related both to anthropogenic activity (Suess effect, "bomb effect"), and to natural fluctuations.

Soil samples were taken from the genetic horizons and then air-dried. All obvious fragments of roots and other unhumified organic material were discarded by hand-picking from peat, litter and mineral soil samples.

Humic acids extracted from soils by the technique accepted in laboratory (Chichagova, 1996). Soil samples were discarded the small roots and plant residues by flotation and then were washed calcium ions free in 0.1M HCl. After this humus acids were separated by 0.1M NaOH, repeatedly. Then humic acid (HA) was precipitated from the separated solution by HCl or H2SO4 in pH=1-2. Sediment of HA was washed acid free with distilled water and was dried. All reactions were at the room temperature.

The objects of research were located at the West Spitsbergen - the largest island of Archipelago Svalbard. The objects of the study are recent soils in the sea terraces (Cryosols, Leptosols) and the soils of rookery located on abrupt slopes.

Most of the described profiles have organic horizon which thickness varies between 1-5 cmdepending on humidifying conditions. The soils of rookery have organic horizon of 40-50 cm thickness. The depth of profile in the studied soils does not exceed 50 cm.

In the studied soils the highest speeds of the carbon exchange are common to the surfacehorizons of rookery soils (Kr 3,94 g/kg C in year). For the surface soils horizons on terraces speed of a carbon exchange is very low (Kr 1,70 g/kg C in year). The rate of renovation of carbon is strongly reduced with the depth. On the depth of 25-30 cm both on terraces, and in rookery soils the age of organic substance varies from 1500±40 BP to 3200±90 BP. On terraces the oldest dates (near 5000 BP) were received for the depth of 50 cm that corresponds to the level of ice permafrost. In the soils of rookery on the depth of 60 cm the radiocarbon age is 4070±40 BP.

It was found that the rate of soil carbon renovation depends on the type of parent material: on calcareous rocks the rate of humic acids renovation is lower than on non-calcareous. It is related to formation in soils on calcareous rocks of humic acids stronger tied with mineral phase, more condensed and more aromatized – all these features result in higher resistance of humic acids of calcareous soils to decomposition and mineralization.

References

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